Massachusetts Institute of Technology
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LUMINARY MEMO #153

TO: Distribution
FROM: S. Albert
DATE: 26 May, 1970
SUBJECT: Variable Servicer Tests

This is a summary of a set of tests run on the Variable Guidance Period Servicer (in version Zerlina) including ascent, aborts from descent, and the thrust programs. It is a follow-up to Luminary Memo # 144 by Don Eyles, which chronicles the Variable Servicer landing tests.

This series included six programs: P12, P70, P71, P40, P41 and P42. Each was run on Luminary as a comparison case, then on Zerlina - first without TLOSS, then with 20% TLOSS - for a total of eighteen tests. P12 and the P70's were run on Zerlina 16 and Luminary 154, whereas the P40's were tested on Zerlina 18 and Luminary 163. This group of tests demonstrated that TLOSS up to 20% did not have a devastating effect on program performance.

Plots of dutycycle and activity are available for each test but not all are given here for reasons of space and economy. Included are guidance period plots for P70 and P71, as well as numerical comparisons of test results for all runs.

1. P12 In the ascent case used, the downrange and radial velocities were changed by astronaut entry and the crossrange was adjusted 1 NM. All three runs achieved ascent trajectories within reasonable limits of the desired injection values. The VG residuals in the run with TLOSS were, however, slightly higher than the other two. (See Chart #1). No guidance period plots are available for these runs. Since, however, all three tests had the same number of passes through Servicer despite V16 monitor activity, it is doubtful whether they constituted a strict enough test of Variable Servicer capabilities.

2. P70 Abort from 46,000'. Numerical results from all three runs compared favorably. The no TLOSS case (see Plot #1) held to a 2-second PGUIDE except for one rise due to V16 activity. The 20% TLOSS case (Plot #2) shows a Profile similar to the landing at 20% TLOSS in Memo #144 up to the point where the abort button is hit. There the guidance period jumps briefly to 3 seconds then settles to a relatively stable PGUIDE lower than its pre-abort level, except for periods when the V16 monitor is active.

3. P71 abort from 30,000'. Again, reasonable results were achieved for injection trajectories in the three tests. The difference between the Luminary case and the Zerlina no TLOSS case in the number of passes through Servicer can be attributed to the fact that Servicer was on over a longer period of time in the Zerlina run, however, Plot #3, it is apparent that the guidance period stayed at 2 seconds, barely affected by extended verbs or V16 monitor operation.

   In the 20% TLOSS case, the guidance period remains below 3 seconds, departing from a post-abort level close to 2 seconds, for V16 activity. During P63, V57 also causes variations in the length of PGUIDE.

4. P40. The performance level of all three tests during an 18-second DPS burn was good, with the 20% TLOSS case losing only one pass through Servicer. PGUIDE, during the no TLOSS case, remained at 2 seconds - the fact that it has one less Servicer cycle than the Luminary case is due to a shorter duration of Servicer operation.

5. P41. Test objectives were achieved in all three cases. The cause of the disparity in cycles between Luminary and the no - TLOSS Zerlina case is the same as stated above for P40.

6. P42. Satisfactory test results were attained; however, the time element was never crucial enough to cause a noticeable lengthening of PGUIDE since the 20% TLOSS case made the same number of passes through Servicer as the Luminary case.

   I am doing further testing on the P40's via Rollbacks and extended verb activity since, in these nominal cases, the effects of high TLOSS (20%) were almost negligible.

P12

	Luminary 154	Zerlina 16	
		No TLOS S	20% TLOSS
Liftoff:	389580.39	389580.39	389580.39
Engine off:	390001.77	39001.85	39001.82
Residual VG's (from edit)	.41, -.99, 1.89fps	.22, -.81, 1.77 fps	-.9, -.2.26, 1.94 fps
Desired out-of-plane distance	-284422.9'	-284422.9'	-284422.9'
Actual "	-284447.8'	-284405.5'	-284397.5'
Desired $\dot{R}$; $\dot{Z}$	30;5529.9fps	30;5529.9 fps	30;5529.9 fps
Actual $\dot{R}$; $\dot{Z}$	29.6; 5528.0 fps	29.8; 5528.1 fps	30.9; 5527.9 fps
Cycles:	253	253	253
RCS:	92.9 lbs.	92.6 lbs.	93.9 lbs.

P40

	Luminary 163	Zerlina 18	
		No TLOSS	20%TLOSS
T16	401424.41	401424.42	401424.41
DPS off:	401452.93	401453.05	401452.9
N40 at cutoff	2.9, 78.0 fps	2.7, 78.5 fps	2.6, 78.6 fps
Residual VG's (N85)	.4, -.3, -.1fps	.1, -.2, .2 fps	.6, 0, .2 fps
Cycles:	36	35	34
RCS:	8.5	7.4 lbs.	7.5 lbs.

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P41

	Luminary 163	Zerlina 18	
		No TLOSS	20 % TLOSS
Subprogram 7			
Begin:	401423.26	401423.28	401423.5
End:	401487.26	401487.28	401487.5
N40 VG:	9.5 fps	9.5 fps	9.5 fps
Residual VGs	-.1, 0, -.1 fps	-.1, .1, -.3 fps	-.2, .1, -.3 fps
Cycles	51	50	49
RCS	42.2 lbs	42.5 lbs.	43 lbs.

P42

	Luminary 163	Zerlina 18	
		No TLOSS	20% TLOSS
V6 desired: (N 40)	295.5 fps	295.5 fps	295.5 fps
T16:	392387.33	392387.32	392387.32
APS off:	392414.09	392413.99	392414.08
N40 at cutoff:	11.0, 283.9, fps	9.8, 285.4 fps	8.9, 286.3 fps
Residual VG's (N85)	-.1, -.2, -.6 fps	.8, 0, -.3 fps	-.4, -.1, -.7fps
Cycles:	38	38	38
RCS:	11.88 lbs.	12.22 lbs.	12.3 lbs.

P70

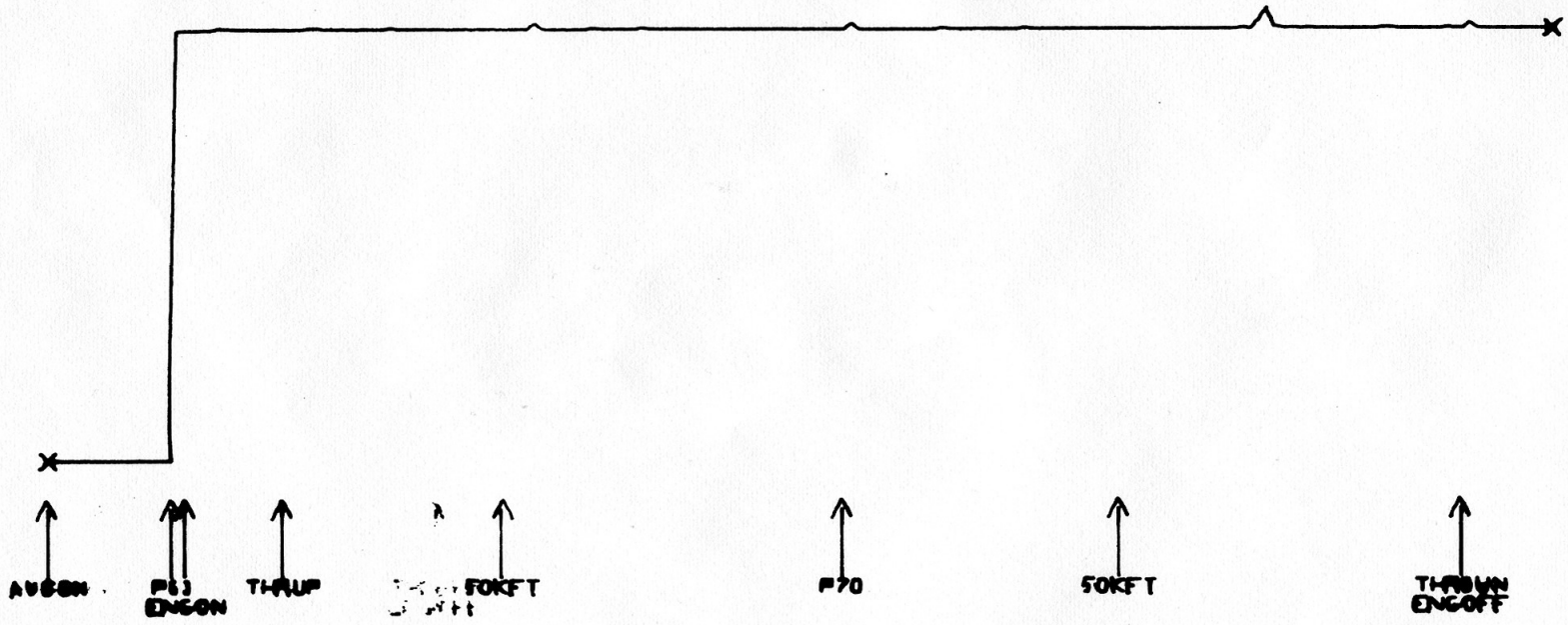
	Luminary 154	Zerlina 16	
		No TLOSS	20% TLOSS
Abort button:	388478.44	388481.44	388478.53
DPS off:	388629.00	388633.62	388478.53
Apogee, Perigee	140.4, 9.8 NM	140.3, 9.8 NM	140.4, 9.8 NM
$\dot{R}$; $\dot{Z}$ at cutoff	19.4, 5660.8 fps	19.4, 5660.7 fps	19.1, 5660.8 fps
Altitude	60036.7 ft.	60036.6 ft.	60052.9 ft.
Residual VG's (from edit)	.11, .03, .43 fps	.13, .04, .42 fps	.44, -.12, .4 fps
Cycles:	185	185	167
RCS:	12.43 lbs.	12.47 lbs.	12.57 lbs.

P71

	Luminary 154	Zerlina 16	
		No TLOSS	20% TLOSS
Abort stage bit	388656.74	388669.74	388670.83
APS on:	388657.53	388670.54	388671.62
APS off:	388975.1	388998.67	389002.34
Desired $\dot{R}$; $\dot{Z}$	5647.8, 19.5 fps	5677.8, 19.5 fps	5677.0, 19.5 fps
Achieved $\dot{R}$; $\dot{Z}$	5643.9, 19.9 fps	5668.8, 20.1 fps	5664.9, 19.6 fps
Residual VG's	-.4, -.11, -.23	-.62, -.36, -.05	.16, -.41, 3.26
Altitude:	60078 ft.	60060 ft.	60079 ft.
Cycles:	355	366	332
RCS:	71.40 lbs.	72.11 lbs.	75.921 lbs.

GUIDANCE PERIOD

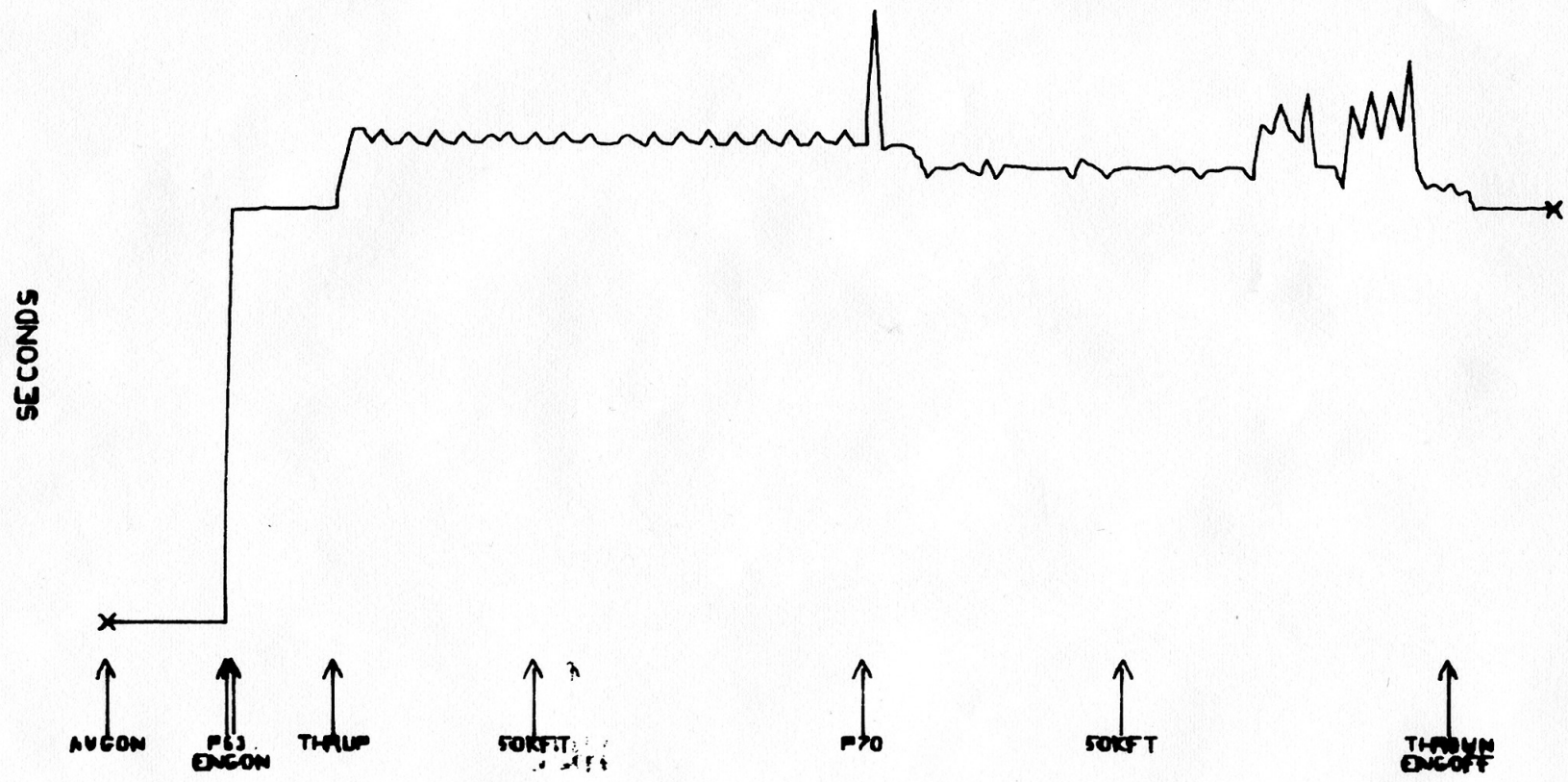
MARSROT NUMBER 09105110
P70 ABORT (ZERLINA 16)



GUIDANCE PERIOD

(2)

MARSROT NUMBER 09300232
P70 ABORT WITH 20* TLOSS (REVISION 16)



SECONDS G.E.T.

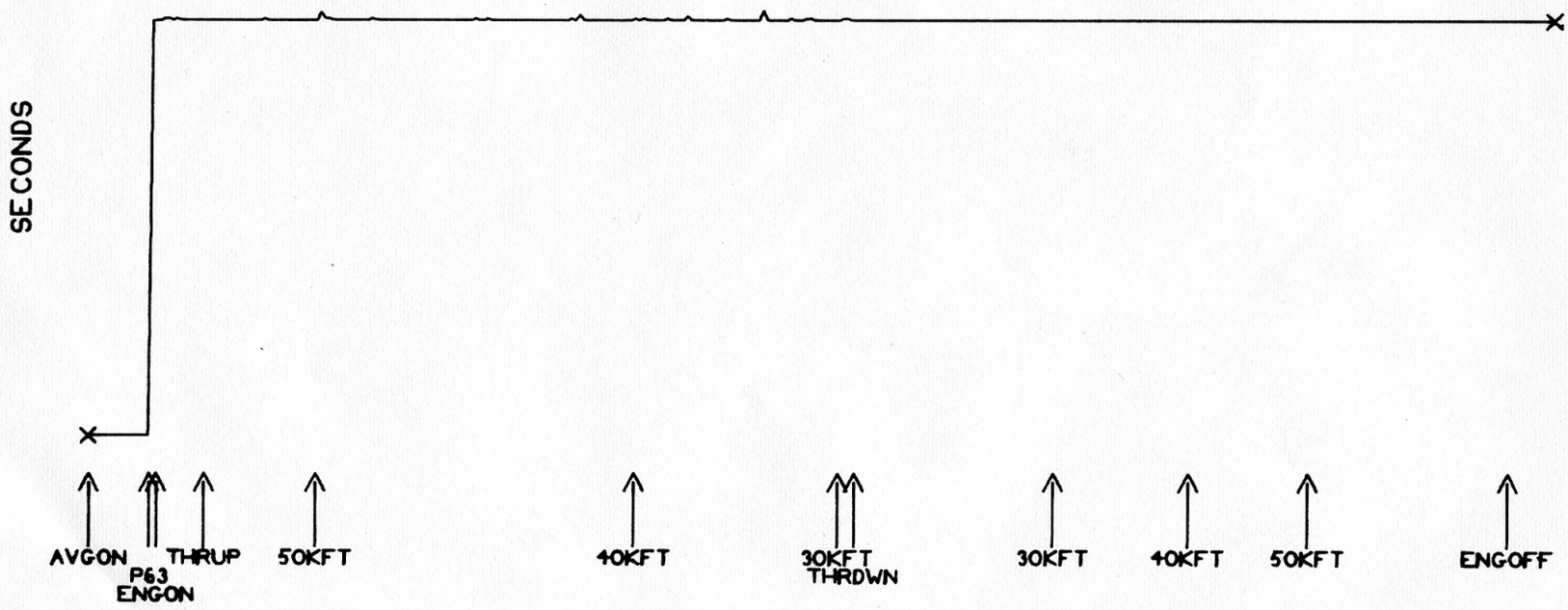
388300 388400 388500 388600

01

(3)

GUIDANCE PERIOD

MARSROT NUMBER 08714002
ZERLINA 16 P71 ABORT WITH 0 TLOSS



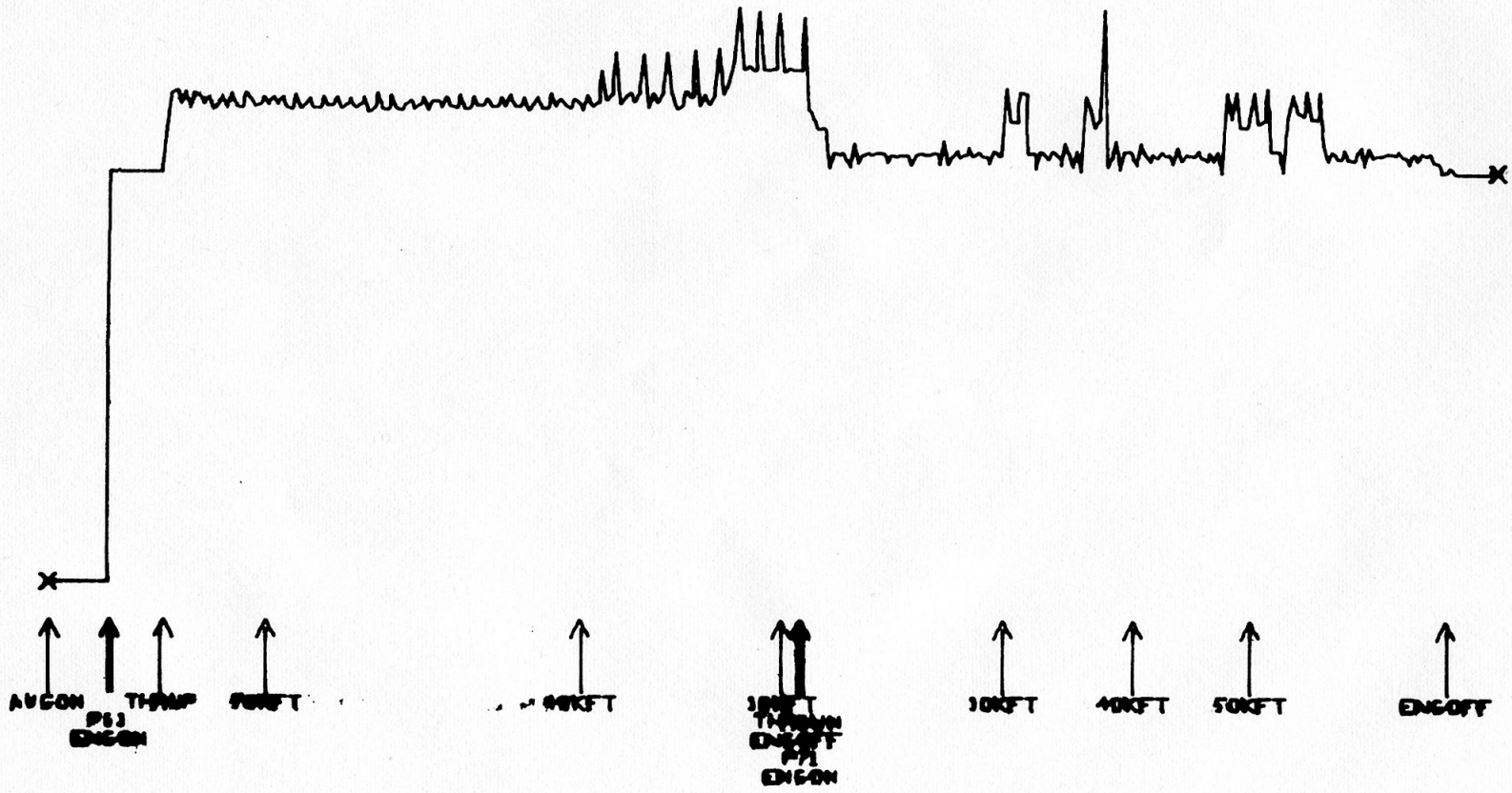
SECONDS G.E.T.

388300 388400 388500 388600 388700 388800 388900 389000

GUIDANCE PERIOD

(4)

MARSROT NUMBER 09516005
ZERLINA 16 P71 ABORT WITH 20* TLOSS



SECONDS G.E.T.

388300 388400 388500 388600 388700 388800 388900 389000